* NOTICES *

CLAIMS

[Claim(s)]

[Claim 1] The gas sensor equipped with the gas limit introduction means given to the cathode of each above in order to restrict the solid electrolyte board which fixes at the front face and rear face of the aforementioned electrical heater, respectively, the porous cathode and positive electrode which are supported by these solid electrolyte board a lot every, and diffusion of measured gas, while indicating oxygen ion good conductivity to be the electrical heater of a tabular in which oxygen ion insulation is shown.

[Claim 2] The gas sensor equipped with the gas limit introduction means given to the cathode of each above in order to restrict the solid electrolyte board which fixes to the main end face of the aforementioned electrical heater, the porous cathode group and positive electrode which are supported by this solid electrolyte board, and diffusion of measured gas, while indicating oxygen ion good conductivity to be the electrical heater of a tabular in which oxygen ion insulation is shown.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to the gas sensor which measures two or more kinds of gas concentration, such as oxygen, carbon dioxide gas, and humidity.
[0002]
[Description of the Prior Art] The following are known as technology which measures the gas concentration of two kinds of gas (for example, oxygen and a steam).
(a) Measure an oxygen density by the oxygen sensor and measure a water vapor content by the humidity sensor.
(b) Change in the time of measuring the time of measuring an oxygen density for the applied-voltage value from which the limiting current value proportional to gas concentration is acquired using an oxygen sensor, and a water vapor content.
[0003]
[Problem(s) to be Solved by the Invention] However, the above-mentioned Prior art has the following faults. Two kinds of sensors are required for the former, and it requires cost. The latter requires time for converging, even if it changes applied voltage, and cannot measure gas concentration of each gas on real time. The purpose of this invention is in offer of the gas sensor which can measure simultaneously the gas concentration of at least two kinds of gas.
[0004]
[Means for Solving the Problem] The following composition was used for this invention in order to solve the above-mentioned technical problem.
(1) In order to restrict the electrical heater of a tabular in which oxygen ion insulation is shown, the solid electrolyte board which fixes at the front face and rear face of the aforementioned electrical heater, respectively while oxygen ion good conductivity is shown, the porous cathode and positive electrode which are supported by these solid electrolyte board a lot every, and diffusion of measured gas, it has the gas limit introduction means given to the cathode of each above.
(2) In order to restrict the electrical heater of a tabular in which oxygen ion insulation is shown, the solid electrolyte board which fixes to the main end face of the aforementioned electrical heater while oxygen ion good conductivity is shown, the porous cathode group and positive electrode which are supported by this solid electrolyte board, and diffusion of measured gas, it has the gas limit introduction means given to the cathode of each above.
[0005]
[Function and Effect(s) of the Invention]
(claim 1) The solid electrolyte board which supported a porous cathode and a porous positive electrode the lot every and in which oxygen ion good conductivity is shown was fixed at the front face and rear face of an electrical heater of a tabular which show oxygen ion insulation, and the gas limit introduction means is given to them at each cathode. For this reason, it is the cathode of one solid electrolyte board about the voltage from which the limiting current value proportional to the gas concentration of a certain kind of gas is acquired. - It is the cathode of the solid electrolyte board of another side about the voltage from which the limiting current value which was impressed by positive inter-electrode and is proportional to the gas concentration of the gas of another kind is acquired. - It becomes possible to be impressed by positive inter-electrode, and a gas sensor can measure the gas concentration of two kinds of gas simultaneously.
(claim 2) The solid electrolyte board which supported a porous cathode group and a porous positive electrode and in which oxygen ion good conductivity is shown was fixed to the main end face of the electrical heater of a tabular in which oxygen ion insulation is shown, and the gas limit introduction means is given to it at each cathode. For this reason, it is each cathode of a solid electrolyte board about different voltage from which the limiting current value proportional to the gas concentration of a type of gas to detect is acquired. - It becomes possible to be impressed by positive inter-electrode, and a gas sensor can measure the gas concentration of two or more kinds of gas simultaneously.
[0006]
[Example] The 1st of this invention and the 2nd example (it corresponds to a claim 1) are explained based on drawing 1 - drawing 5 . The gas sensor A of the 1st example shown in drawing 1 and drawing 2 The ceramic heater 1 which shows oxygen ion insulation, and the stabilized-zirconia boards 2 and 3 which are solid electrolyte boards which fix at the front face and rear face of this ceramic heater 1, and in which oxygen ion good conductivity is shown, It has this stabilized-zirconia board 2, the positive electrode 21 put in order and laid underground into three, a cathode 22 and the positive electrode 31, a cathode 32, the

gas outlet holes 23 and 33 that are gas derivation meanses, and a gas limit introduction means. Moreover, in the gas sensor B of the 2nd example shown in drawing 3 , the positive electrode 21, a cathode 22 and the positive electrode 31, and a cathode 32 install in the front face of the stabilized-zirconia boards 2 and 3 side by side, and are allotted, and it is laid underground into the ceramic board 4 in which oxygen ion insulation is shown and which makes an alumina a subject, and 5.

[0007] As shown in drawing 4 , a ceramic heater 1 lays a tungsten 12 underground into the ceramic 11 which makes an alumina a subject, depends on connecting platinum wires 13 and 14 to the power supply for heaters (not shown), generates heat, and carries out partial heating of the electrode sections 21a, 31a, 22a, and 32a of the positive electrodes 21 and 31 and cathodes 22 and 32 at 300 degrees C - 700 degrees C. In addition, as for the exoergic section and 122, 121 is [the electrode section and 15] bleeders.

[0008] The stabilized-zirconia boards 2 and 3 are the solid electrolytes which carried out addition dissolution of the yttrium oxide as a stabilizing agent, and present 0.3mm in thickness, 5mm long, and a 23mm wide size to a zirconium oxide by this example. In addition, 20 is a bleeder.

[0009] The positive electrodes 21 and 31 and cathodes 22 and 32 are porous platinum layers (the number of thickness 10 micrometers), and have one side of about 2mm electrode sections 21a, 31a, 22a, and 32a, the pars intermedia 21b and 22b (a part of thing which hid below is not shown) of a narrow width, and the edges 21c and 22c to which platinum wires 24 and 25 are connected.

[0010] The gas outlet holes 23 and 33 are holes drilled by the stabilized-zirconia boards 2 and 3 of electrode section 21a and 31a position, and open the electrode sections 21a and 31a and the exterior for free passage. In addition, the gas outlet holes 23 and 33 may be big things to which electrode section 21a and the whole 31a are exposed. A gas limit introduction means consists of gas induction 26 which exposed the platinum layer of pars intermedia 22b to the skin of the stabilized-zirconia board 2, and the gaseous diffusion limit section 27 which restricts the introduced diffusion of gas.

[0011] Below, the manufacture method (principal part) of gas sensors A and B is described. After printing a heater pattern with the paste made from a tungsten and putting platinum wires 13 and 14 on an edge, a ceramic heater 1 puts the same green sheet, carries out the baking unification of this, and is manufactured by the upper surface of the green sheet of 96 % of the weight of aluminas which drilled the aperture which serves as a bleeder 15 after baking (refer to drawing 4). After printing a platinum paste after baking so that it may become the positive electrode 21 and a cathode 22, and carrying platinum wires 24 and 25 at the edge on the solid electrolyte green sheet which drilled the aperture which serves as a bleeder 20 after baking, the laminating of another solid electrolyte green sheet (in the case of a gas sensor A) or the isomorphous alumina green sheet (in the case of a gas sensor B) is carried out, it really calcinates at 1500 degrees C, and a sensor element (illustration near side) is manufactured. After printing a platinum paste so that it may become the positive electrode 31 and a cathode 32 after baking, and carrying a platinum wire at the edge on the solid electrolyte green sheet which similarly drilled the aperture which serves as a bleeder after baking, the laminating of another solid electrolyte green sheet (in the case of a gas sensor A) or the isomorphous alumina green sheet (in the case of a gas sensor B) is carried out, it really calcinates at 1500 degrees C, and a sensor element (illustration other side) is manufactured. Each sensor element is sealed on the rear face and front face of a ceramic heater 1 using sealing glass (about 800 degrees C), and serves as gas sensors A and B.

[0012] Below, operation of gas sensors A and B is explained. Gas sensors A and B are allotted into measured gas, and it energizes to a ceramic heater 1, and is the positive electrode 21. - Between cathodes 22 and positive electrode 31 - Voltage is impressed between cathodes 32. The oxygen inside polar-zone 22a (32a) of a cathode 22 (32) is ionized, and serves as oxygen ion, and the pumping of the oxygen in measured gas is carried out to the positive electrode 21 (31) from a cathode 22 (32) according to applied voltage V. At this time, partial heating only of the polar-zone 22a (32a) is carried out by the cathode 22 (32), and since the gaseous diffusion limit section 27 is not fully heated so that it shows oxygen ion conductivity, it diffuses oxygen in a cathode 22 (32) from the gas induction 26. Here, it is the positive electrode 21 (31). - The current I which flows between cathodes 22 (32) changes, as shown in drawing 5 . Since applied voltage V is controlled by the gas induction 26 of a cathode 22 (32) in the voltage values V1-V2 and it is restricted according to the oxygen density in measured gas, a diffusing capacity is restricted, current value is also restricted in connection with it, and the oxygen diffusing capacity into a cathode 22 (32) serves as the diffusion limit current value IL 1, and serves as the 1st flat part F1. the voltage value V2 from which the diffusion discharge voltage value IL 1 is acquired for applied voltage V -- further -- high -- becoming (more than 1.2V) -- the steam in measured gas (moisture) is electrolyzed, since the pumping of the oxygen ion produced in the decomposition is carried out to the positive electrode 21 (31), a steam is also diffused into a cathode 22 (32) from the gas induction 26 of a cathode 22 (32), and current value increases according to a diffusing capacity Although current value will increase further according to steam concentration if applied voltage V is made still higher and it is made the voltage values V3-V4, the diffusing capacity of a steam is restricted by the gas induction 26 of a cathode 22 (32), current value is also restricted in connection with it, it becomes the diffusion limit current value IL 2 according to steam concentration, and the 2nd flat part F2 is shown. For example, if the voltage of V1-V2 is impressed to the sensor element of a near side and the diffusion limit current value IL 1 is measured, an oxygen density is detectable from the size of the diffusion limit current value IL 1. Moreover, if the voltage of V3-V4 is simultaneously impressed to the sensor element of the other side and the diffusion limit current value IL 2 is measured, humidity is detectable from the size of the diffusion limit current value IL 2.

[0013] Gas sensors A and B can measure the oxygen density and humidity in measured gas on real time simultaneously.

[0014] The 3rd example (it corresponds to a claim 1) of this invention is explained based on drawing 6 and drawing 7 . A gas sensor C is equipped with the stabilized-zirconia boards 2 and 3 which are solid electrolyte boards which fix at a part of front face of the ceramic heater 1 which shows oxygen ion insulation, and this ceramic heater 1, and the rear face, and in which oxygen ion

good conductivity is shown, this stabilized-zirconia board 2, the positive electrode 21 put in order and arranged in three and a cathode 22 (a part of hidden thing is not shown hereafter), the gas-outlet hole 23 which is a gas derivation means, and a gas limit introduction means. In addition, you may be the structure currently laid underground into the ceramic board with which an alumina is made into a subject where 2 sets of positive electrodes and a cathode are installed in the front face of the stabilized-zirconia boards 2 and 3 side by side, and show oxygen ion insulation, like the 2nd example.

[0015] The ceramic heater 1 is the same as the composition of the 1st example except the point of performing instead of [of platinum wires 13 and 14] by the electrodes 131 and 141 for heater energization exposed to ceramic 11 front face. The stabilized-zirconia boards 2 and 3 are the solid electrolytes of the same material as the 1st example, and the thing of this example presents 0.3mm in thickness, 5mm long, and a 7mm wide size. The positive electrode 21 and a cathode 22 are porous platinum layers (the number of thickness 10 micrometers), and have the one-side about 2mm polar zone 21a and 22a, and the narrow connections 21d and 22d. The composition of the gas outlet hole 23 and a gas limit introduction means is the same as the 1st example.

[0016] Below, the manufacture method (principal part) of a gas sensor C is described. By the method according to the 1st example, membrane surface attachment of laying under the ground of a tungsten 12, the electrodes 131 and 141 for heater energization, and the sensor electrodes 151 and 152 (ruthenium oxide) is performed, and a ceramic heater 1 is manufactured. On a solid electrolyte green sheet, a platinum paste is printed, it really calcinates at 1500 degrees C, and a sensor element main part (illustration near side) is manufactured so that it may become the positive electrode 21 and a cathode 22 after baking. Similarly, the sensor element of the illustration other side is also manufactured. In order to aim at the internal positive electrode 21, a cathode 22 and the sensor electrodes 151 and 152, and an electric flow, a golden paste is applied in between with the sensor electrode 151, 21d of connections, and the sensor electrode 152 and 22d of connections. Each sensor element main part is sealed on the rear face and front face of a ceramic heater 1 using sealing glass (not shown) (about 800 degrees C), and a gas sensor C is completed.

[0017] The gas sensor C of this example can operate according to gas sensors A and B, and the oxygen density and humidity in measured gas can be simultaneously measured on real time. Since the gas sensor C of this example can attain snug rank-ization of the stabilized-zirconia boards 2 and 3, it can manufacture from the thing of the 1st and the 2nd example to a low cost.

[0018] The 4th of this invention and the 5th example (it corresponds to a claim 2) are explained based on drawing 8 and drawing 9 . The gas sensor D of the 4th example of this invention shown in drawing 8 is equipped with the ceramic heater 1 which shows oxygen ion insulation, the stabilized-zirconia board 6 which is a solid electrolyte board which fixes on the front face of this ceramic heater 1, and in which oxygen ion good conductivity is shown, the positive electrode 61 put in order and laid underground into this stabilized-zirconia board 6, a cathode 62 and a cathode 63, the gas outlet hole 64 which is a gas derivation means, and a gas limit introduction means. Moreover, in the gas sensor E of the 5th example shown in drawing 9 , the positive electrode 61 and cathodes 62 and 63 install in the front face of the stabilized-zirconia board 6 side by side, and are allotted, and it is laid underground into the ceramic board 7 in which oxygen ion insulation is shown and which makes an alumina a subject.

[0019] A ceramic heater 1 uses the drawing 7 article as the base, and is carrying out film attachment of the sensor electrodes 161, 162, and 163 (ruthenium oxide) at this. This ceramic heater 1 carries out local heating of the polar zone 61a, 62a, and 63a. The size and the quality of the material of the stabilized-zirconia board 6 are the same as that of drawing 6 . The positive electrode 61 of a gas sensor D and cathodes 62 and 63 are laid underground into the stabilized-zirconia board 6 using the method according to the 1st example. Moreover, the positive electrode 61 of a gas sensor E and cathodes 62 and 63 are laid underground into the ceramic board 7 using the method according to the 2nd example. the composition of the gas outlet hole 64 and the gas limit introduction meanses 621 and 631 -- the 1st example and parenchyma -- it is the same

[0020] Below, the manufacture method (principal part) of gas sensors D and E is described. By the method according to the 3rd example, membrane surface attachment of laying under the ground of a tungsten 12, the electrodes 131 and 141 for heater energization, and the sensor electrodes 161, 162, and 163 (ruthenium oxide) is performed, and a ceramic heater 1 is manufactured. On a solid electrolyte green sheet, a platinum paste is printed so that it may become the positive electrode 61 and cathodes 62 and 63 after baking, the laminating of another solid electrolyte green sheet (gas sensor D) or the isomorphous alumina green sheet (gas sensor E) is carried out, it really calcinates at 1500 degrees C, and a sensor element is manufactured. In order to aim at the internal positive electrode 61, cathodes 62 and 63 and the sensor electrodes 161, 162, and 163, and an electric flow, a golden paste is applied the sensor electrode 161, connection 61b and the sensor electrode 162, connection 62b and the sensor electrode 163 and connection 63b, and in between. A sensor element main part is sealed on the front face of a ceramic heater 1 using sealing glass (not shown) (about 800 degrees C), and gas sensors D and E are completed.

[0021] The voltage for making the sensor electrode 161 into a reference electrode, for example, measuring an oxygen density between the sensor electrode 161-sensor electrodes 163 is impressed, and it is the sensor electrode 161. - It depends on impressing the voltage for measuring humidity between the sensor electrodes 162, and the gas sensors D and E as well as gas sensors A, B, and C can operate, and can measure the oxygen density and humidity in measured gas on real time simultaneously. the gas sensors D and E of this example can attain further snug rank-ization of the stabilized-zirconia board 6 (since it is one-sheet use) -- it is -- it can manufacture from the thing of the 3rd example to a low cost further

[0022] this invention includes the following embodiment in addition to the above-mentioned example.

a. the cathode group of a claim 2 -- three or more -- carrying out -- cathode - Positive inter-electrode applied voltage is changed respectively, and you may enable it to measure simultaneously three or more (others -- CO2 and NO2) kinds of gas concentration by one gas sensor.

b. In a claim 2, a solid electrolyte board may be fixed to both sides of an electrical heater, and a gas sensor may be manufactured.
c. When it sticks being supported by the solid electrolyte board to the front face (or rear face) of a solid electrolyte board and is allotted, contain in both cases of being laid underground into a solid electrolyte board.
d. The gas outlet holes 23, 33, and 64 of a size and a configuration are arbitrary if more flow rates than a gas limit introduction means are obtained.

[Translation done.]

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 05-087773
(43)Date of publication of application : 06.04.1993

(51)Int.Cl. G01N 27/41
G01N 27/416

(21)Application number : 03-252202
(22)Date of filing : 30.09.1991

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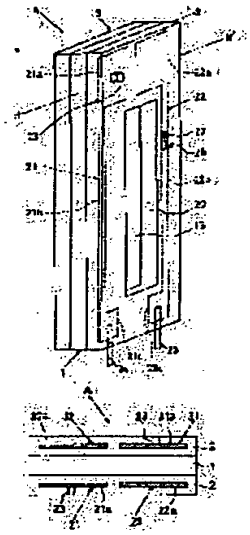
(54) GAS SENSOR

(57)Abstract:
PURPOSE: To obtain a gas sensor capable of measuring the concns. of at least two kinds of gases at the same time.
CONSTITUTION: A gas sensor is equipped with a ceramic heater 1, the stabilized zirconia plates 2, 3 fixed to the upper and rear surfaces of said heater, the anodes 21, 31 and cathodes 22, 32 embedded in the stabilized zirconia plates 2, 3 in parallel, a gas lead-out means constituted of outlets 23, 33 and a gas restricting and introducing means constituted of a gas introducing part 26 and a gas diffusion control part 27.



LEGAL STATUS

[Date of request for examination] 31.07.1998
[Date of sending the examiner's decision of rejection]
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]
[Date of final disposal for application]
[Patent number]
[Date of registration]
[Number of appeal against examiner's decision of rejection]
[Date of requesting appeal against examiner's decision of rejection]
[Date of extinction of right]

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号

特開平5－87773

(43)公開日　平成５年(1993)４月６日

(51)Int.Cl.[5]	識別記号	庁内整理番号	ＦＩ		技術表示箇所
Ｇ０１Ｎ　27/41					
27/416					
		6923－2Ｊ	Ｇ０１Ｎ　27/46	３２５　Ｚ	
		6923－2Ｊ		３１１　Ｊ	
		6923－2Ｊ		３３１	

審査請求　未請求　請求項の数２(全　６　頁)

(21)出願番号　特願平3－252202

(22)出願日　平成３年(1991)９月30日

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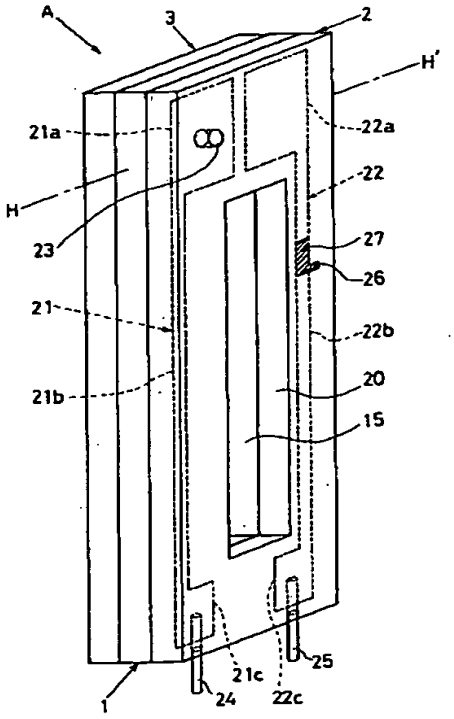
(54)【発明の名称】　ガスセンサ

(57)【要約】

【目的】　少なくとも二種類のガスのガス濃度を同時に測定することができるガスセンサの提供。

【構成】　セラミックヒータ１と、その表面及び裏面に固着される安定化ジルコニア板２、３と、安定化ジルコニア板２、３中に並べて埋設される陽電極２１、陰電極２２、及び陽電極３１、陰電極３２と、ガス出口穴２３、３３で構成したガス導出手段と、ガス導入部２６及びガス拡散制御部２７で構成したガス制限導入手段とを備える。



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【特許請求の範囲】

【請求項１】　酸素イオン絶縁性を示す板状の電熱ヒータと、

酸素イオン良導電性を示すとともに、前記電熱ヒータの表面及び裏面にそれぞれ固着される固体電解質板と、

これら固体電解質板に一組ずつ担持される、多孔質の陰電極及び陽電極と、

被測定ガスの拡散を制限する為、上記それぞれの陰電極に付与されるガス制限導入手段とを備えるガスセンサ。

【請求項２】　酸素イオン絶縁性を示す板状の電熱ヒータと、

酸素イオン良導電性を示すとともに、前記電熱ヒータの主端面に固着される固体電解質板と、

該固体電解質板に担持される、多孔質の陰電極群及び陽電極と、

被測定ガスの拡散を制限する為、上記それぞれの陰電極に付与されるガス制限導入手段とを備えるガスセンサ。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、酸素、炭酸ガス、湿度など、二種類以上のガス濃度を測定するガスセンサに関する。

【０００２】

【従来の技術】二種類のガス（例えば酸素と水蒸気）のガス濃度を測定する技術として以下のものが知られている。

（ア）酸素濃度を酸素センサで測定し、水蒸気量を湿度センサで測定する。

（イ）酸素センサを用い、ガス濃度に比例した限界電流値が得られる印加電圧値を、酸素濃度を測定する時と水蒸気量を測定する時とで変える。

【０００３】

【発明が解決しようとする課題】しかるに、上記従来の技術は以下の様な欠点がある。前者は、二種類のセンサが必要でありコストがかかる。後者は、印加電圧を変えても収束するのに時間がかかり、リアルタイムで各ガスのガス濃度が測定できない。本発明の目的は、少なくとも二種類のガスのガス濃度を同時に測定することができるガスセンサの提供にある。

【０００４】

【課題を解決するための手段】上記課題を解決する為、本発明は、以下の構成を採用した。

（１）酸素イオン絶縁性を示す板状の電熱ヒータと、酸素イオン良導電性を示すとともに、前記電熱ヒータの表面及び裏面にそれぞれ固着される固体電解質板と、これら固体電解質板に一組ずつ担持される、多孔質の陰電極及び陽電極と、被測定ガスの拡散を制限する為、上記それぞれの陰電極に付与されるガス制限導入手段とを備える。

（２）酸素イオン絶縁性を示す板状の電熱ヒータと、酸素イオン良導電性を示すとともに、前記電熱ヒータの主端面に固着される固体電解質板と、該固体電解質板に担持される、多孔質の陰電極群及び陽電極と、被測定ガスの拡散を制限する為、上記それぞれの陰電極に付与されるガス制限導入手段とを備える。

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【０００５】

【作用及び発明の効果】

（請求項１について）酸素イオン絶縁性を示す板状の電熱ヒータの表面及び裏面に、多孔質の陰電極及び陽電極を一組ずつ担持した、酸素イオン良導電性を示す固体電解質板を固着し、それぞれの陰電極にガス制限導入手段を付与している。この為、ある種類のガスのガス濃度に比例した限界電流値が得られる電圧を一方の固体電解質板の陰電極- 陽電極間に印加し、別の種類のガスのガス濃度に比例した限界電流値が得られる電圧を他方の固体電解質板の陰電極- 陽電極間に印加することが可能となり、ガスセンサは、同時に、二種類のガスのガス濃度が測定できる。

（請求項２について）酸素イオン絶縁性を示す板状の電熱ヒータの主端面に、多孔質の陰電極群及び陽電極を担持した、酸素イオン良導電性を示す固体電解質板を固着し、それぞれの陰電極にガス制限導入手段を付与している。この為、検出したいガス種のガス濃度に比例した限界電流値が得られる異なる電圧を固体電解質板の各陰電極- 陽電極間に印加することが可能となり、ガスセンサは、同時に、二種類以上のガスのガス濃度が測定できる。

【０００６】

【実施例】本発明の第１、第２実施例（請求項１に対応）を図１～図５に基づいて説明する。図１、図２に示す第１実施例のガスセンサＡは、酸素イオン絶縁性を示すセラミックヒータ１と、このセラミックヒータ１の表面及び裏面に固着される、酸素イオン良導電性を示す固体電解質板である安定化ジルコニア板２、３と、この安定化ジルコニア板２、３中に並べて埋設される陽電極２１、陰電極２２及び陽電極３１、陰電極３２と、ガス導出手段であるガス出口穴２３、３３と、ガス制限導入手段とを備える。また、図３に示す第２実施例のガスセンサＢでは、陽電極２１、陰電極２２及び陽電極３１、陰電極３２が、安定化ジルコニア板２、３の表面に並設して配され、酸素イオン絶縁性を示す、アルミナを主体とするセラミック板４、５中に埋設されている。

【０００７】セラミックヒータ１は、図４に示す様に、アルミナを主体とするセラミック１１中にタングステン１２を埋設したものであり、白金線１３、１４をヒータ一用電源（図示せず）に接続することに拠り発熱し、陽電極２１、３１及び陰電極２２、３２の電極部２１ａ、３１ａ、２２ａ、３２ａを３００℃～７００℃に局所加熱する。尚、１２１は発熱部、１２２は電極部、１５は通気口である。

【０００８】安定化ジルコニア板２、３は、酸化ジルコニウムに、安定化剤として酸化イットリウムを添加固溶させた固体電解質であり、本実施例では、厚さ０．３ｍｍ、縦５ｍｍ、横２３ｍｍの大きさを呈する。なお、２０は通気口である。

【０００９】陽電極２１、３１、陰電極２２、３２は、多孔質の白金層（厚さ数十μｍ）であり、一辺約２ｍｍの電極部２１ａ、３１ａ、２２ａ、３２ａと、細幅の中間部２１ｂ、２２ｂ（以下隠れたものは一部図示しない）と、白金線２４、２５が接続される端部２１ｃ、２２ｃとを有する。

【００１０】ガス出口穴２３、３３は、電極部２１ａ、３１ａ位置の安定化ジルコニア板２、３に穿設された穴であり、電極部２１ａ、３１ａと外部とを連通する。尚、ガス出口穴２３、３３は、電極部２１ａ、３１ａ全体を露出させる大きなものであっても良い。ガス制限導入手段は、中間部２２ｂの白金層を安定化ジルコニア板２の外壁面に露出させたガス導入部２６、及び導入したガスの拡散を制限するガス拡散制限部２７で構成される。

【００１１】つぎに、ガスセンサＡ、Ｂの製造方法（主要部）を述べる。セラミックヒータ１は、焼成後に通気口１５となる窓を穿設したアルミナ９６重量％のグリーンシートの上面に、タングステン製のペーストでヒータパターンを印刷し、端部に白金線１３、１４を載せた後、同様のグリーンシートを被せ、これを焼成一体化して製造される（図４参照）。焼成後に通気口２０となる窓を穿設した固体電解質グリーンシート上に、焼成後、陽電極２１、陰電極２２となる様に白金ペーストを印刷し、端部に白金線２４、２５を載せた後、別の固体電解質グリーンシート（ガスセンサＡの場合）、又は同形のアルミナグリーンシート（ガスセンサＢの場合）を積層し、１５００℃で一体焼成してセンサ素子（図示手前側）を製造する。同様に、焼成後に通気口となる窓を穿設した固体電解質グリーンシート上に、焼成後に陽電極３１、陰電極３２となる様に白金ペーストを印刷し、端部に白金線を載せた後、別の固体電解質グリーンシート（ガスセンサＡの場合）、又は同形のアルミナグリーンシート（ガスセンサＢの場合）を積層し、１５００℃で一体焼成してセンサ素子（図示向こう側）を製造する。各センサ素子は、封着ガラスを用いてセラミックヒータ１の裏面及び表面に封着（約８００℃）されガスセンサＡ、Ｂとなる。

【００１２】つぎに、ガスセンサＡ、Ｂの動作を説明する。ガスセンサＡ、Ｂを被測定ガス中に配し、セラミックヒータ１に通電し、陽電極２１－陰電極２２間、及び陽電極３１－陰電極３２間に電圧を印加する。陰電極２２（３２）の電極部２２ａ（３２ａ）内部の酸素は、イオン化されて酸素イオンとなり、被測定ガス中の酸素は、印加電圧Ｖに応じ、陰電極２２（３２）から陽電極

２１（３１）にポンピングされる。この時、陰電極２２（３２）では電極部２２ａ（３２ａ）のみ局所加熱され、ガス拡散制限部２７は酸素イオン導電性を示す程充分に加熱されない為、酸素はガス導入部２６から陰電極２２（３２）内に拡散する。ここで、陽電極２１（３１）－陰電極２２（３２）間に流れる電流Ｉは、図５に示す様に変化する。印加電圧Ｖが電圧値Ｖ１～Ｖ２においては、陰電極２２（３２）内への酸素拡散量は、陰電極２２（３２）のガス導入部２６で制御され、被測定ガス中の酸素濃度に応じて制限される為拡散量が制限され、それに伴い電流値も制限されて拡散制限電流値I_{L1}となり、第１の平坦部Ｆ１となる。印加電圧Ｖが拡散制限電圧値I_{L1}が得られる電圧値Ｖ２よりさらに高くなる（１．２Ｖ以上）と、被測定ガス中の水蒸気（水分）が電気分解され、その分解で生じた酸素イオンが陽電極２１（３１）にポンピングされる為、水蒸気も陰電極２２（３２）のガス導入部２６から陰電極２２（３２）内へ拡散し、拡散量に応じて電流値が増大する。印加電圧Ｖをさらに高くして電圧値Ｖ３～Ｖ４にすると電流値は水蒸気濃度に応じてさらに増大するが、陰電極２２（３２）のガス導入部２６で水蒸気の拡散量が制限され、それに伴い電流値も制限され、水蒸気濃度に応じた拡散制限電流値I_{L2}となり、第２の平坦部Ｆ２を示す。例えば、手前側のセンサ素子にＶ１～Ｖ２の電圧を印加して拡散制限電流値I_{L1}を測定すれば拡散制限電流値I_{L1}の大きさから酸素濃度が検出できる。また、同時に向こう側のセンサ素子にＶ３～Ｖ４の電圧を印加して拡散制限電流値I_{L2}を測定すれば拡散制限電流値I_{L2}の大きさから湿度が検出できる。

【００１３】ガスセンサＡ、Ｂは、被測定ガス中の、酸素濃度と湿度とを同時にリアルタイムで測定することができる。

【００１４】本発明の第３実施例（請求項１に対応）を図６及び図７に基づいて説明する。ガスセンサＣは、酸素イオン絶縁性を示すセラミックヒータ１と、このセラミックヒータ１の表面及び裏面の一部に固着される、酸素イオン良導電性を示す固体電解質板である安定化ジルコニア板２、３と、この安定化ジルコニア板２、３内に並べて配設される陽電極２１、陰電極２２（以下、隠れたものは一部図示しない）と、ガス導出手段であるガス出口穴２３と、ガス制限導入手段とを備える。尚、第２実施例の様に、二組の陽電極、陰電極が、安定化ジルコニア板２、３の表面に並設され、且つ酸素イオン絶縁性を示す、アルミナを主体とするセラミック板中に埋設されている構造であっても良い。

【００１５】セラミックヒータ１は、白金線１３、１４の替わりをセラミック１１表面に露出したヒータ通電用電極１３１、１４１で行っている点以外は第１実施例の構成と同じである。安定化ジルコニア板２、３は、第１実施例と同一材料の固体電解質であり、本実施例のもの

は、厚さ０．３ｍｍ、縦５ｍｍ、横７ｍｍの大きさを呈する。陽電極２１、陰電極２２は、多孔質の白金層（厚さ数十μｍ）であり、一辺約２ｍｍの電極部２１ａ、２２ａと、幅狭の接続部２１ｄ、２２ｄとを有する。ガス出口穴２３及びガス制限導入手段の構成は、第１実施例と同じである。

【００１６】つぎに、ガスセンサＣの製造方法（主要部）を述べる。第１実施例に準じた方法で、タングステン１２の埋設、ヒータ通電用電極１３１、１４１、及びセンサ電極１５１、１５２（酸化ルテニウム）の表面膜付けを行い、セラミックヒータ１を製造する。固体電解質グリーンシート上に、焼成後に陽電極２１、陰電極２２となる様に白金ペーストを印刷し１５００℃で一体焼成してセンサ素子本体（図示手前側）を製造する。同様に、図示向こう側のセンサ素子も製造する。内部の陽電極２１、陰電極２２とセンサ電極１５１、１５２と電気的導通を図る為、センサ電極１５１と接続部２１ｄ、及びセンサ電極１５２と接続部２２ｄと間に金ペーストを塗布する。各センサ素子本体を、封着ガラス（図示せず）を用いてセラミックヒータ１の裏面及び表面に封着（約８００℃）しガスセンサＣが完成する。

【００１７】本実施例のガスセンサＣも、ガスセンサＡ、Ｂに準じて動作し、被測定ガス中の、酸素濃度と湿度とを同時にリアルタイムで測定することができる。本実施例のガスセンサＣは、安定化ジルコニア板２、３の小体格化が図れるので、第１、第２実施例のものより低コストに製造できる。

【００１８】本発明の第４、第５実施例（請求項２に対応）を図８及び図９に基づいて説明する。図８に示す、本発明の第４実施例のガスセンサＤは、酸素イオン絶縁性を示すセラミックヒータ１と、このセラミックヒータ１の表面に固着される、酸素イオン良導電性を示す固体電解質板である安定化ジルコニア板６と、この安定化ジルコニア板６中に並べて埋設される陽電極６１、陰電極６２、陰電極６３と、ガス導出手段であるガス出口穴６４と、ガス制限導入手段とを備える。また、図９に示す第５実施例のガスセンサＥでは、陽電極６１、陰電極６２、６３が、安定化ジルコニア板６の表面に並設して配され、酸素イオン絶縁性を示す、アルミナを主体とするセラミック板７中に埋設されている。

【００１９】セラミックヒータ１は、図７品をベースにし、これにセンサ電極１６１、１６２、１６３（酸化ルテニウム）を膜付けしている。このセラミックヒータ１は、電極部６１ａ、６２ａ、６３ａを局部加熱する。安定化ジルコニア板６の大きさや材質は図６と同一である。ガスセンサＤの陽電極６１、陰電極６２、６３は、第１実施例に準じた方法を用いて安定化ジルコニア板６中に埋設されている。また、ガスセンサＥの陽電極６１、陰電極６２、６３は、第２実施例に準じた方法を用いてセラミック板７中に埋設されている。ガス出口穴６４、ガス制限導入手段６２１、６３１の構成は、第１実施例と実質同一である。

【００２０】つぎに、ガスセンサＤ、Ｅの製造方法（主要部）を述べる。第３実施例に準じた方法で、タングステン１２の埋設、ヒータ通電用電極１３１、１４１、及びセンサ電極１６１、１６２、１６３（酸化ルテニウム）の表面膜付けを行いセラミックヒータ１を製造する。固体電解質グリーンシート上に、焼成後に陽電極６１、陰電極６２、６３となる様に白金ペーストを印刷し、別の固体電解質グリーンシート（ガスセンサＤ）、または同形のアルミナグリーンシート（ガスセンサＥ）を積層し、１５００℃で一体焼成してセンサ素子を製造する。内部の陽電極６１、陰電極６２、６３とセンサ電極１６１、１６２、１６３と電気的導通を図る為、センサ電極１６１と接続部６１ｂ、センサ電極１６２と接続部６２ｂ、及びセンサ電極１６３と接続部６３ｂと間に、金ペーストを塗布する。センサ素子本体を、封着ガラス（図示せず）を用いてセラミックヒータ１の表面に封着（約８００℃）しガスセンサＤ、Ｅが完成する。

【００２１】センサ電極１６１を基準電極とし、例えば、センサ電極１６１-センサ電極１６３間に酸素濃度を測定する為の電圧を印加し、センサ電極１６１－センサ電極１６２間に湿度を測定する為の電圧を印加することに拠り、ガスセンサＤ、Ｅも、ガスセンサＡ、Ｂ、Ｃと同様に動作し、被測定ガス中の、酸素濃度と湿度とを同時にリアルタイムで測定することができる。本実施例のガスセンサＤ、Ｅは、安定化ジルコニア板６の更なる小体格化が図れる（一枚使用の為）ので、第３実施例のものより一層、低コストに製造できる。

【００２２】本発明は、上記実施例以外に、つぎの実施態様を含む。

ａ．請求項２の陰電極群を三以上とし、陰電極－陽電極間の印加電圧を各々変えて、一つのガスセンサで、三種類以上（他にCO_2、NO_2）のガス濃度を同時に測定できる様にしても良い。

ｂ．請求項２において、電熱ヒータの両面に固体電解質板を固着してガスセンサを製造しても良い。

ｃ．固体電解質板に担持されるとは、固体電解質板の表面（又は裏面）に密着して配される場合、及び固体電解質板中に埋設される場合の両方を含む。

ｄ．ガス出口穴２３、３３、６４は、ガス制限導入手段よりも多い流量が得られれば、大きさ及び形状は任意である。

【図面の簡単な説明】

【図１】本発明の第１実施例に係るガスセンサの構造説明図である。

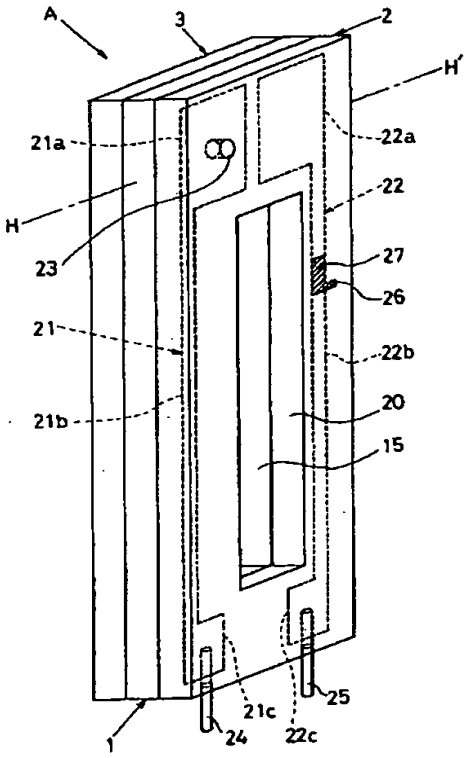
【図２】そのガスセンサのH－ H’線断面図である。

【図３】本発明の第２実施例に係るガスセンサの構造説明図である。

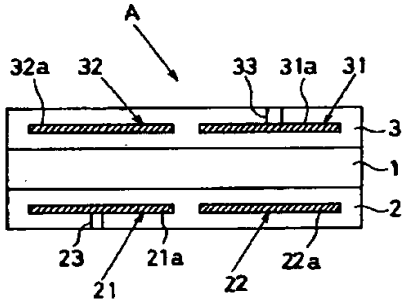
【図４】第１、第２実施例に係るガスセンサのセラミッ

クヒータの構造説明図である。
【図５】それらガスセンサの動作を説明する為のグラフである。
【図６】本発明の第３実施例に係るガスセンサの構造説明図である。
【図７】そのガスセンサのセラミックヒータの構造説明図である。
【図８】本発明の第４実施例に係るガスセンサの構造説明図である。
【図９】本発明の第５実施例に係るガスセンサの構造説明図である。
【符号の説明】
A、B、C、D、E　　ガスセンサ
１　セラミックヒータ（電熱ヒータ）
２、３、６　安定化ジルコニア板（固体電解質板）
２１、３１、６１　陽電極
２２、３２、６２、６３　陰電極
６２１、６３１　ガス制限導入手段

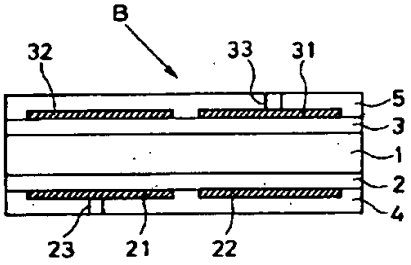
【図１】



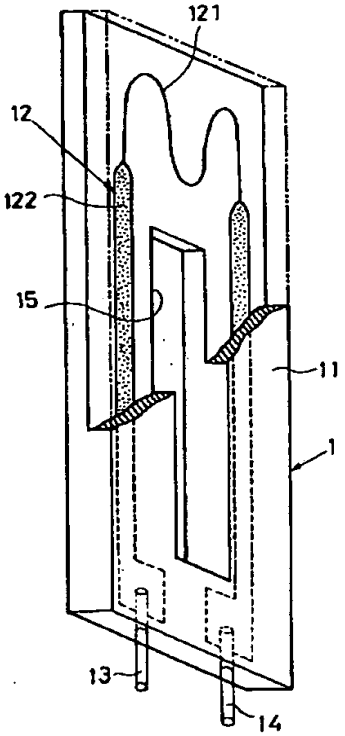
【図２】



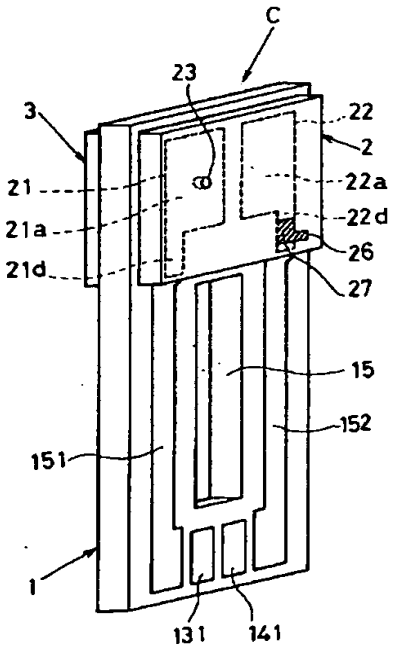
【図３】



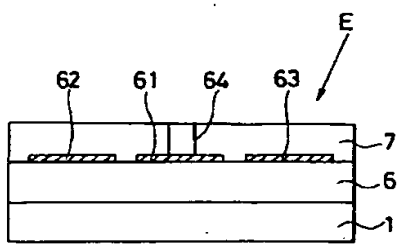
【図４】



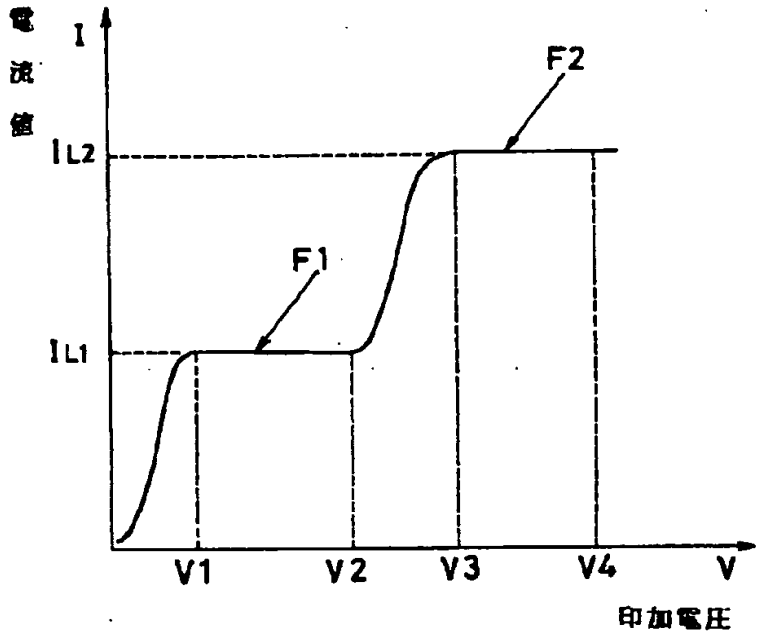
【図６】



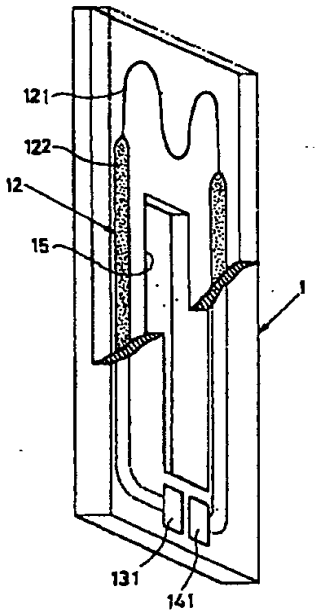
【図９】



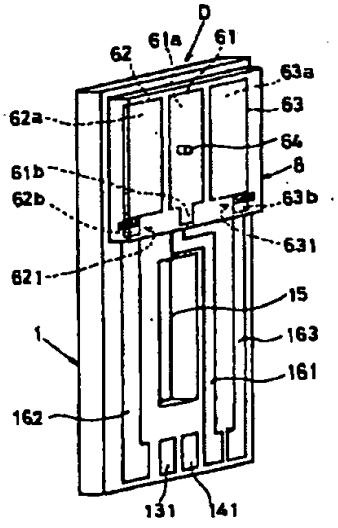
【図5】


電流値
I
F2
IL2
F1
IL1
V1
V2
V3
V4
V
印加電圧

【図7】


121
122
12
15
1
131
141

【図8】


D
62
61a
61
63a
62a
63
64
61b
8
62b
63b
631
621
15
1
163
161
162
131
141